

DETAILED ACTION

Response to Arguments

1. Applicant's arguments with respect to claims 11-16 have been considered but are moot in view of the new ground(s) of rejection.

The Applicant has cancelled all previous claims, and merely states that features of new claims are not taught nor rendered obvious by the prior art of record, without discussion. The Examiner does not consider the amendment fully responsive, yet considers that the Applicant attempts to advance prosecution in good faith.

Claim Objections

2. Claims 11 and 14 objected to because of the following informalities:

Claims 11 and 14 recite "may not be **liner** controlled" in the last line in each claim, where --may not be linearly controlled-- is intended.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. **Claims 11-16** are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Admitted Prior Art (*page 1, line 14 to page 4, line 4 of the disclosure; "AAPA" hereinafter*) in view of Piestun et al. (*Synthesis of Three Dimensional Light Fields and Applications; "Piestun" hereinafter*).

Regarding claim 11, AAPA teaches a three-dimensional image display device which irradiates illuminating light on a display device and displays a three-dimensional image on an image reconstruction display unit using illuminating light transmitted through the display device (*see page 1, lines 14-20*), comprising a control image optimizing unit, wherein the control image optimizing unit is configured to: calculate a solution of the three-dimensional image based on a solution of control image included in a calculation target region (*see page 2, lines 24-28; see lines 2-5 for performing optimization in such a display through simulated annealing; the Examiner considers that naming the components that perform this action as a unit is merely an organization abstraction without architectural significance; even if architectural significance was given, the Examiner considers well-known to achieve complex tasks using a plurality of devices, thereby allowing parallel execution and specialized hardware design, improving performance*) and perform an evaluating process for evaluating whether or not the solution of three-dimensional image is an optimized solution; perform a solution changing process for changing the solution of a control image included in the calculation target region by a move operation; determine an optimized solution of three-dimensional image by repeating the evaluating process and the solution changing process; and

record a control image on the display device based on the solution of the control image corresponding to the optimized solution of the three-dimensional image (*see page 2, line 2, to page 3, line 5; these limitations amount to the well-known simulated annealing method in holography; see page 1, lines 14-20 for recording the image*).

AAPA does not teach excluding, from the calculation target region, a region where an amplitude amount of the illuminating light transmitted through the display device is lower than a threshold or a region where an amplitude of the illuminating light transmitted through the display device may not be linearly controlled.

Note: The Examiner interprets amplitude not being linearly controlled as used by the Applicant (*see page 22, lines 10-16*), that is for values below a minimum or maximum value achievable by the device.

Piestun however teaches techniques for synthesizing light fields, with particular use in holography (*see abstract; see page 223, 2nd col. 5th par.*), the techniques achieving simplification of the dimensionality of the solution, and contrasting the ideal models for light modulation devices with the limitations of the physical devices, in particular to computer-controlled devices (*see page 224, 2nd col., two last pars.; see page 225, 1st col., 1st, 2nd and 6th pars, the latter discussing the devices as electronically controlled*), further discussing wavefronts that modulate amplitude and phase, the encoding of said wavefronts to present images at a certain distance requiring discrete representations in order to be stored in a computer, taking into account the type of modulation available and subject to iterative optimization (*see page 225, 2nd col., 2nd par., points 1-3 of 3rd par. and last par.*).

Piestun discusses at length the limitations of physical devices and how the limitations are considered as constraints into the calculations, in particular, limited space-bandwidth product and restrictive wavefront modulation capacity (*see page 226, 1st col. 1st and 2nd pars.*) where said limitations cause the optimization to be constrained by said limitations, since the ideal reconstruction may not be achievable (*see page 226, 1st col., 3rd par.*), and further considering that in any finite system there are cutoff frequencies such that energy propagated beyond is attenuated and can be ignored (*see page 226, 2nd col. 1st par.*). Piestun describes how practical systems can only use only a part of the spherical domain (*see page 227, 1st col, 2nd par.*), and how these systems have cutoffs for achievable intensity where this intensity is negligible and how their limits result in limits in the space domain (*see page 227, col. 2, 2nd and 3rd pars*), leading Piestun to not requiring the full 3D region to be encoded into a 2D hologram (*see page 227, 2nd col., 4th par.*). Piestun therefore explicitly suggests considering intensity distributions and restricting the space domain (*see page 228, section labeled B, 1st par. and points 1 and 2*), originating a procedure for space-domain synthesis that defines signals based on intensity, takes into account device limitations, and finishes by optimizing the constrained solution space (*see pages 229 and 230, section IV, points 1, 4 and 6-8; see page 231, 2nd col. last par.*), outlining simulated annealing as one such available optimization algorithm (*see page 231, 1st col., last par.*). Piestun finally also discusses performing amplitude and phase modulations, the latter exemplified by a kinoform, and discusses the consequences of quantization from binary representation in such modulations (*see page 234, 3rd to 6th pars.*).

Because Piestun is aimed at holographic modulation using optimization methods such as Simulated Annealing, an otherwise well-known method in the art, it would have been obvious to one of ordinary skill in the art at the time of the invention to simplify and constrain the solution space for the iterative optimization in Simulated Annealing, as described in AAPA, based on the particular physical limitations of the computer controlled wavefront modulation employed, and further to do so in constraining the solution space by limiting the solutions for which intensity (light amplitude) is cutoff below a meaningful value as taught by Piestun, resulting in space-domain region exclusion as taught by Piestun.

While Piestun does not explicitly discuss areas in which modulation of amplitude cannot be linearly controlled, Piestun does explicitly mention the limits in modulation of the device as one of the constraints imposed in the solution, and therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to exclude from the solution modulation values that cannot be achieved by the waveform, which result in space-domain limitation, as taught by Piestun and are inherent to any physical device, as discussed by Piestun.

Performing these modifications to a Simulated Annealing method as taught by AAPA not only reduces computation, but effectively ensures that non-feasible solutions are not attained.

Regarding claim 12, AAPA and Piestun teach a three-dimensional image display device which irradiates illuminating light on a display device and displays a three-dimensional image on an image reconstruction display unit using illuminating light

transmitted through the display device, comprising a control image optimizing unit, wherein the control image optimizing unit is configured to: calculate a solution of the three-dimensional image based on a solution of a control image included in a calculation target region, and perform an evaluating process for evaluating whether or not the solution of the three-dimensional image is an optimized solution; perform a solution changing process for changing the solution of the control image included in the calculation target region by a move operation; determine an optimized solution of the three-dimensional image by repeating the calculating process and the solution changing process; record a control image on the display device based on the solution of the control image corresponding to the optimized solution of the three-dimensional image (*see claim 11*).

AAPA and Piestun further render obvious determining a changing of a solution changed in the move operation based on a changing unit of an amplitude transmitting ratio of the illuminating light transmitted through the display device or a changing unit of a voltage applied to the display device (*see discussion in claim 11 for taking into account the binarization and quantization of computer-generated wavefronts and for constraining the solution space based on said limitations; it is obvious that said quantization limits the modulation of the device, since the device can only operate at preset quanta of voltage in electronically controlling the waveform, resulting in only a finite set of amplitude modulation achievable*).

Regarding claims 13 and 14, AAPA and Piestun do not explicitly teach that a distance between the display device and the image reconstruction display unit is R , an

angle of a traveling direction of the illuminating light changed at the display device is 0, a visual region of the image reconstruction display unit is defined by the R and the 0, and the calculation target region corresponds to the visual region of the image reconstruction display, although the Examiner considers this implicit (*in Piestun, see Fig. 6; see discussion in claim 11, for distance and for mapping the 3D space into a hologram; see page 223, 2nd col. 5th par; see Fig. 2c; see page 225, 2nd col. , bullet point 1; see page 234, second col., 3rd and 4th pars.; the Examiner considers fundamental in the art that in holography incident light is manipulated through diffractive wavefronts in order to direct light into appropriate regions, and that, naturally, this projection at an angle and distance causes a region of space to represent the object aimed, through the interaction of the waves passing through the different elements in the diffraction grid and their posterior projection through a lens and therefore, that, as taught by Piestun, the solution space for the wavefront corresponds to the visual space-domain; further, by definition, diffraction spreads incoming light over an angle, making possible the interference necessary for hologram representation).*

Regarding claim 15, AAPA and Piestun render obvious a three-dimensional image display method which irradiates illuminating light on a display device and displays a three-dimensional image on an image reconstruction display unit using illuminating light transmitted through the display device, comprising: calculating a solution of the three-dimensional image based on a solution of a control image included in a calculation target region, and performing an evaluating process for evaluating whether or not the solution of the three-dimensional image is an optimized evaluation;

performing a solution changing process for changing the solution of the control image included in the calculation target region by a move operation; determining an optimized solution of the three-dimensional image by repeating the evaluating process and the solution changing process; recording a control image on the display device based on the solution of the control image corresponding to the optimized solution of three-dimensional image; and excluding, from the calculation target region, a region where an amplitude amount of the illuminating light transmitted through the display device is lower than a threshold or a region where an amplitude of the illuminating light transmitted through the display device may not be linearly controlled (*see discussion for claim 11*).

Regarding claim 16, AAPA and Piestun render obvious a three-dimensional image display method which irradiates illuminating light on a display device and displays a three-dimensional image on an image reconstruction display unit using illuminating light transmitted through the display device, comprising: calculating a solution of the three-dimensional image based on a solution of a control image included in a calculation target region, and performing an evaluating process for evaluating whether or not the solution of three-dimensional image is an optimized solution; performing a solution changing process for changing the solution of the control image included in the calculation target region by a move operation; determining an optimized solution of the three-dimensional image by repeating the evaluating process and the solution changing process; recording a control image on the display device based on the solution of the control image corresponding to the optimized solution of the three-dimensional image; and determining a changing of a solution changed in the move operation based on a

changing unit of an amplitude transmitting ratio of the illuminating light transmitted through the display device or a changing unit of a voltage applied to the display device (*see claim 12*).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CARLOS PERROMAT whose telephone number is (571)270-7174. The examiner can normally be reached on M-TH 8:30 am- 5:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kee M. Tung can be reached on (571)272-7794. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Carlos Perromat/

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C.P.